# Runtime Infrastructure F.0 Organization and Function

## Simulation Interoperability Workshop

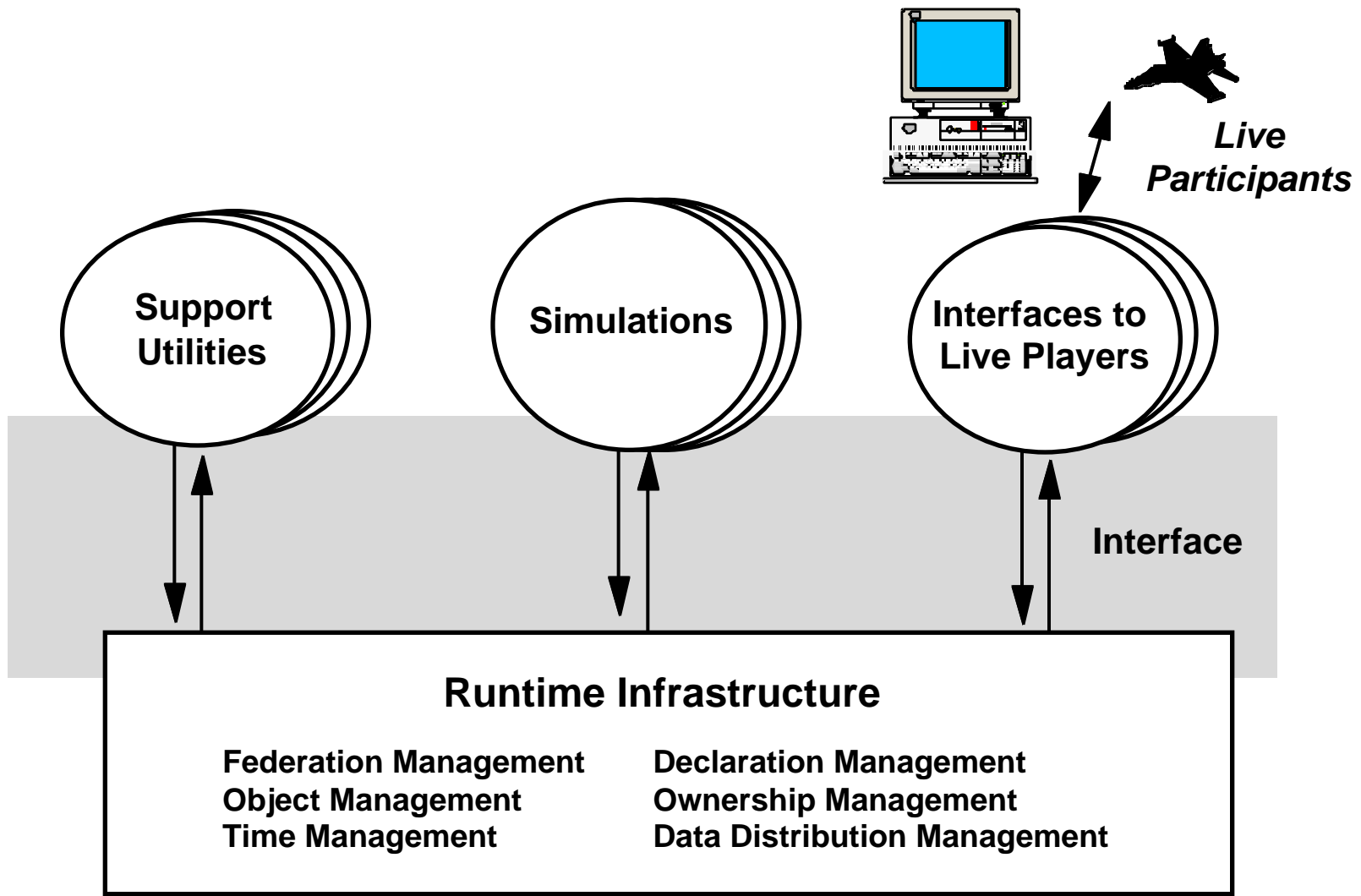**Orlando, Florida**

**Richard Weatherly, Ph.D.**

http://ms.ie.org/weatherly

3 March 1997

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# Functional View of HLA Architecture

**Live Participants**

Support Utilities

Simulations

Interfaces to Live Players

**Interface**

## Runtime Infrastructure

Federation Management          Declaration Management
Object Management              Ownership Management
Time Management                Data Distribution Management

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# Federation Management

2.1    Create Federation Execution

2.2    Destroy Federation Execution

2.3    Join Federation Execution

2.4    Resign Federation Execution

2.5    Request Pause

2.6    Initiate Pause †

2.7    Pause Achieved

2.8    Request Resume

2.9    Initiate Resume †

2.10  Resume Achieved

2.11  Request Federation Save

2.12  Initiate Federate Save †

2.13  Federate Save Begun

2.14  Federate Save Achieved

2.15  Request Restore

2.16  Initiate Restore †

2.17  Restore Achieved

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# Declaration Management

**3.1    Publish Object Class**

**3.2    Publish Interaction Class**

**3.3    Subscribe Object Class Attribute**

**3.4    Subscribe Interaction Class**

**3.5    Control Updates †**

**3.6    Control Interactions †**

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# Object Management

4.1    Request Id

4.2    Register Object

4.3    Update Attribute Values

4.4    Discover Object †

4.5    Reflect Attribute Values †

4.6    Send Interaction

4.7    Receive Interaction †

4.8    Delete Object

4.9    Remove Object †

4.10  Change Attribute Transportation Type

4.11  Change Attribute Order Type

4.12  Change Interaction Transportation Type

4.13  Change Interaction Order Type

4.14  Request Attribute Value Update

4.15  Provide Attribute Value Update †

4.16  Retract

4.17  Reflect Retraction †

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# Ownership Management

5.1   Request Attribute Ownership Divestiture
5.2   Request Attribute Ownership Assumption †
5.3   Attribute Ownership Divestiture Notification †
5.4   Attribute Ownership Acquisition Notification †
5.5   Request Attribute Ownership Acquisition
5.6   Request Attribute Ownership Release †
5.7   Query Attribute Ownership
5.8   Inform Attribute Ownership †
5.9   Is Attribute Owned by Federate

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# Time Management

6.1    **Request Federation Time**

6.2    **Request LBTS**

6.3    **Request Federate Time**

6.4    **Request Minimum Next Event Time**

6.5    **Set Lookahead**

6.6    **Request Lookahead**

6.7    **Time Advance Request Available**

6.8    **Next Event Request Available**

6.9    **Flush Queue Request**

6.10   **Time Advance Grant †**

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# Data Distribution Management

| | |
|---|---|
| **7.1** | **Create Update Region** |
| **7.2** | **Create Subscription Region** |
| **7.3** | **Associate Update Region** |
| **7.4** | **Change Thresholds** † |
| **7.5** | **Modify Region** |
| **7.6** | **Delete Region** |

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# RTI F.0 Package

- **RTI Header Files**

- **RTI Object Libraries**

- **Demonstration Programs**
  - **Jager**
  - **Test Federate**
  - **Hello World**
  - **Java Management Tool**

- **I/F Specification 1.1 HTML Browser**

- **C++ API HTML Browser**

# Basic RTI Code Structure
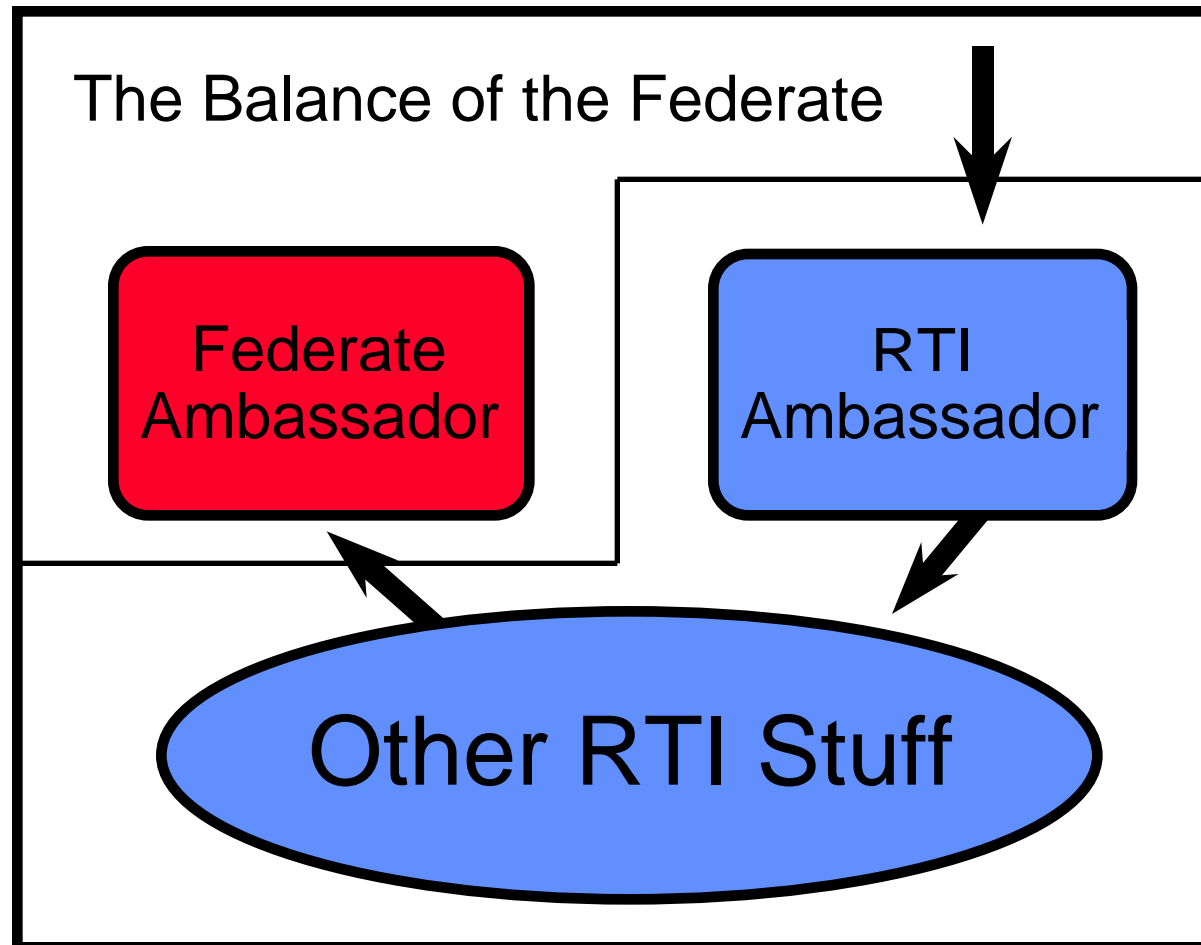
```
class RTI {
public:

  #include "baseTypes.hh
  #include "RTItypes.hh"
  struct RTIambPrivate;

  class RTIambassador {
  public:
    #include "RTIambServices.hh"
  private:
    RTIambPrivate* privateData;
  };


  class FederateAmbassador {
  public:
    #include "federateAmbServices.hh"
  };
};
```
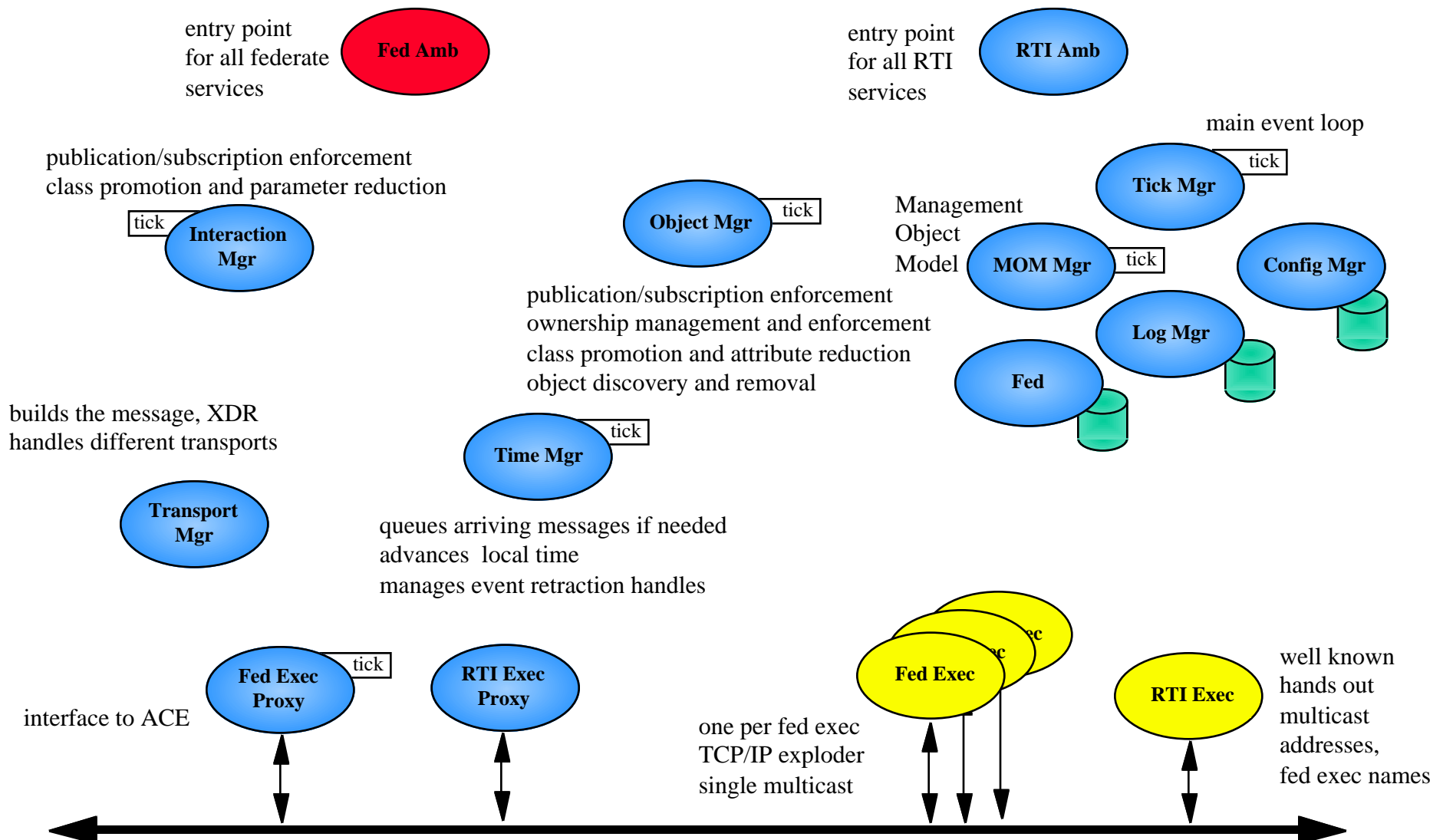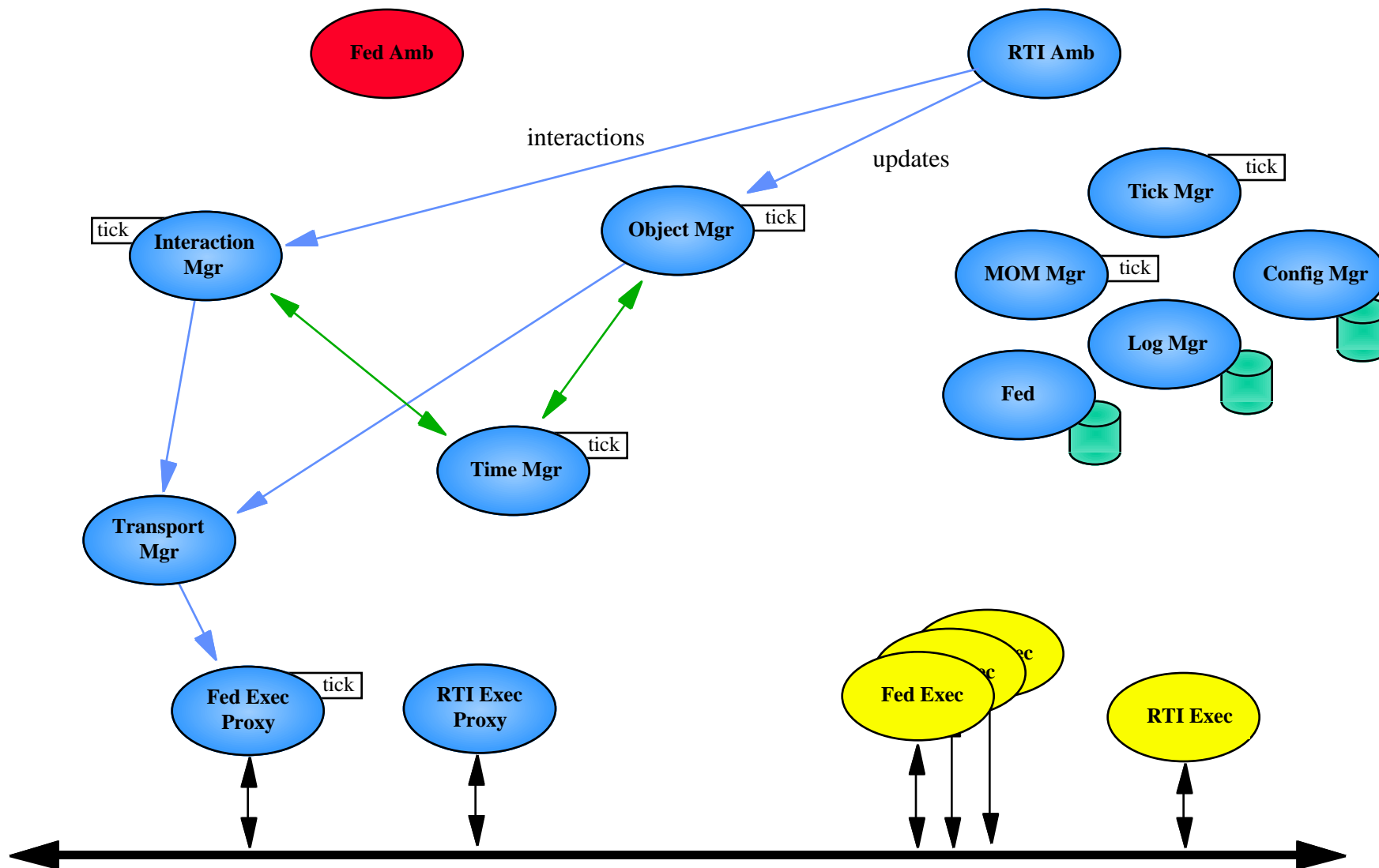
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# Relationship Between
# RTI F.0 and a Single Federate

The Balance of the Federate

Federate Ambassador

RTI Ambassador

Other RTI Stuff

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# Internal View of RTI F.0 and a Single Federate

entry point for all federate services

**Fed Amb**

entry point for all RTI services

**RTI Amb**

main event loop

publication/subscription enforcement
class promotion and parameter reduction

tick

**Interaction Mgr**

**Object Mgr**  tick

Management Object Model

**Tick Mgr**  tick

**MOM Mgr**  tick

**Config Mgr**

publication/subscription enforcement
ownership management and enforcement
class promotion and attribute reduction
object discovery and removal

**Log Mgr**

**Fed**

builds the message, XDR
handles different transports

**Time Mgr**  tick

**Transport Mgr**

queues arriving messages if needed
advances  local time
manages event retraction handles

**Fed Exec Proxy**  tick

**RTI Exec Proxy**

**Fed Exec**

ec

ec

**RTI Exec**

interface to ACE

one per fed exec
TCP/IP exploder
single multicast

well known
hands out
multicast
addresses,
fed exec names

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# The Generation of Interactions and Updates

Fed Amb

RTI Amb

interactions

updates

tick

Tick Mgr

tick

Interaction Mgr

tick

Object Mgr

tick

MOM Mgr

Config Mgr

Log Mgr

Fed

tick

Time Mgr

Transport Mgr

Fed Exec Proxy

tick

RTI Exec Proxy

Fed Exec

RTI Exec

# The Reception of Interactions and Updates



interaction

reflection
delete object

retraction handles

Fed Amb

RTI Amb

Interaction Mgr — tick

Object Mgr — tick

Tick Mgr — tick

MOM Mgr — tick

Config Mgr

Log Mgr

Fed

Time Mgr — tick

Transport Mgr

Fed Exec Proxy — tick

RTI Exec Proxy

Fed Exec

RTI Exec

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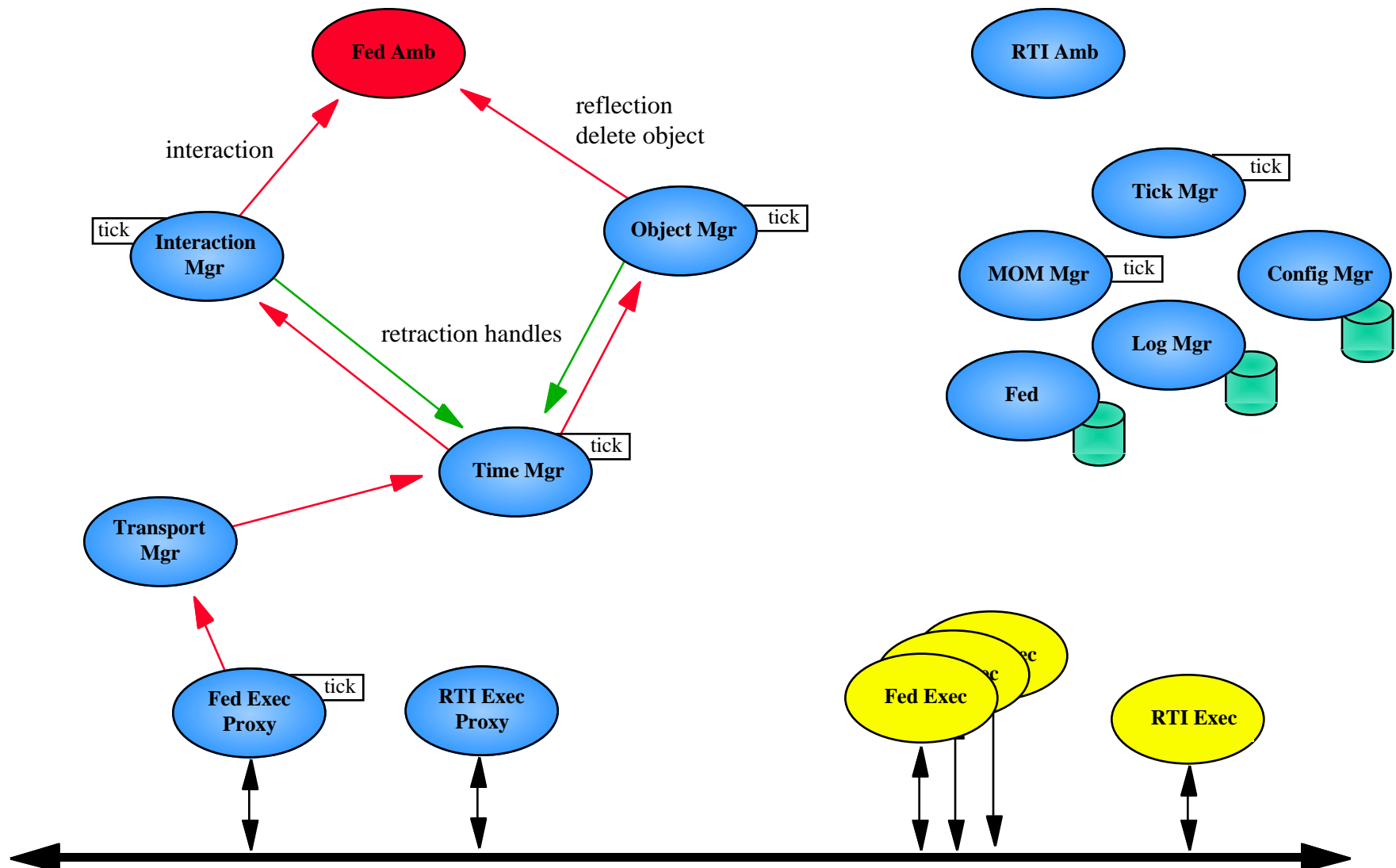
# Basic MOM Manager Actions

- Generate interactions when something interesting happens

- Respond to control interactions that modify the state of the RTI

- Create management objects on behalf of the federate and federation

- Update attributes of management objects in a desired way

- Respond to Request Attribute Update for management object attributes

- Allow the federation designers to extend the basic MOM classes

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# Object Class Manager.Federate

```
(class Manager
    (class Federate
        (attribute FederateFederation        FED_RELIABLE FED_RECEIVE)
        (attribute FederateHost              FED_RELIABLE FED_RECEIVE)
        (attribute FederateHandle            FED_RELIABLE FED_RECEIVE)
        (attribute FederateLookahead         FED_RELIABLE FED_RECEIVE)
        (attribute FederateName              FED_RELIABLE FED_RECEIVE)
        (attribute RTIversion                FED_RELIABLE FED_RECEIVE)
        (attribute FederateTime              FED_RELIABLE FED_RECEIVE)
        (attribute TimeConstrained           FED_RELIABLE FED_RECEIVE)
        (attribute TimeRegulating            FED_RELIABLE FED_RECEIVE)
        (attribute FIFOlength                FED_RELIABLE FED_RECEIVE)
        (attribute TSOlength                 FED_RELIABLE FED_RECEIVE)
        (attribute TotalObjectCount          FED_RELIABLE FED_RECEIVE)
        (attribute HoldingTokensObjectCount  FED_RELIABLE FED_RECEIVE)
        (attribute DeletedObjectCount        FED_RELIABLE FED_RECEIVE)
        (attribute NumAttributes             FED_RELIABLE FED_RECEIVE)
        (attribute NumParameters             FED_RELIABLE FED_RECEIVE)
    )
  )
)
```

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# Interaction Class Manager.Federate

```
(class Manager                              FED_RELIABLE FED_RECEIVE
    (class Federate                         FED_RELIABLE FED_RECEIVE
        (parameter FromFederate)
        (class Alert                        FED_RELIABLE FED_RECEIVE
            (parameter AlertSeverity)
            (parameter AlertText)
            (parameter AlertID))
        (class ServiceLog                   FED_RELIABLE FED_RECEIVE
            (parameter ServiceName)
            (parameter ServiceInitiator))
        (class Action                       FED_RELIABLE FED_RECEIVE
            (parameter ToFederate)
            (class SetTiming                FED_RELIABLE FED_RECEIVE
                (parameter Lookahead)
                (parameter TimeConstrained)
                (parameter TimeRegulating)
                (parameter FedReportPeriod)
                (parameter TimeReportPeriod)
                (parameter ObjectReportPeriod))
            (class SetServiceLogging         FED_RELIABLE FED_RECEIVE
                (parameter SetLogging)))))))
```

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# Operation of the MOM Manager

Fed Amb

RTI Amb

Tick Mgr — tick

tick — Interaction Mgr

Object Mgr — tick

MOM Mgr — tick

Config Mgr

Fed

Log Mgr

Time Mgr — tick

Transport Mgr

Fed Exec Proxy — tick

RTI Exec Proxy

Fed Exec

Fed Exec

RTI Exec